HAND-BOOK OF TREE-PLANTING

N. H. EGLESTON

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HAND-BOOK

OF

TREE-PLANTING;

OR,

WHY TO PLANT,
WHERE TO PLANT,
WHAT TO PLANT,
HOW TO PLANT.

BY

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"Ye may be aye stickin' in a tree, Jock;
it will be growin' when ye're sleepin'."
—*Scotch Farmer.*

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INTRODUCTION.

THE special object of this book is to treat of the planting of trees in masses. It is not designed so much for the amateur, or the ornamental planter, as for the one who is desirous of cultivating trees on the large scale, and with a view to profit rather than to adornment or mere æsthetic effect. It aims to meet the want of land-owners, more especially of those whose lot is cast in portions of the country destitute or nearly so of trees, and who feel the need of them, whether for fuel, as a source of lumber, for shelter, or for companionship, but who are inexperienced in the cultivation of trees, and so far ignorant of their qualities and adaptations to various soils and climates, that they are at a loss what to plant, or as to the best method to be pursued in their cultivation. It does not, therefore, undertake to discuss the respective merits of the wide range of ornamental trees, properly

so called, or even to go over the catalogue of trees indigenous to this country, more than four hundred in number, but treats only of a limited class and such as have a recognized economic value that commends them to the attention of any who are desirous of planting for use and profit.

But while this is the author's special object, he has endeavored to treat the subject in such a manner as will make the work a proper guide to the tree-planter, whoever he may be, or whatever may be his object in planting. The laws of growth and the conditions of success in planting are essentially the same, whether one plants a forest or a single tree, whether he plants for use or for ornament. Economic considerations may lead to a variation of treatment in some respects. These are easily specified, but the general principles which govern all cases alike remain the same.

It has seemed to the author that he might best meet the demands of the subject by casting what he has to say in the form of answers to the specific questions—Why to plant? Where to plant? What to plant? and How to plant?

I.

WHY TO PLANT.

TREE-PLANTING, except for ornamental purposes, as in door-yards, along the borders of streets, and occasionally in lawns and parks, and to a certain extent by orchardists, has hardly been a subject of consideration in this country until within a comparatively recent period of time. Planting in masses, so that the result should take on a forest appearance, has been thought of only in rare instances. Our thought and corresponding action have been in quite the opposite direction. From the first settlement of the country we have been engaged, with stout arms and resolute will, in destroying the forests. At the outset such action was often a necessity. The land was almost entirely forest-covered. Settlement could be made only as room for agriculture and pasturage was gained by removing

the dense masses of trees, whose leafy tops shut out the sunlight and whose roots defied the plow. Accordingly, they were made away with, and in the speediest manner possible. They were felled by wholesale, and burned by the acre upon the ground where they lay. Wood was worthless, except for the scanty needs of fuel and house-building. The pioneer could hardly have too little of it. The forests were in the way. They were almost a nuisance; and a man was famous in proportion as, in the language of Scripture, "he had lifted up the axe among the thick trees."

The feeling engendered in that early time has characterized our people ever since. We have continued to make ruthless warfare upon the woods. The trees have continued to be in the way as the population has increased and the tide of migration has swept westward from the Atlantic coast. Naturally our best friends, we have come to regard them as our natural enemies. The forests, the slow growth of centuries, have been held as an impediment to the national growth, and one of our States has even taken for its seal and heraldic device the

figure of a wood-chopper with his axe lifted on high to smite the trees. It might be taken as the characteristic emblem of the nation.

At length we have hewed our path through the seemingly interminable forest and come out upon the treeless plains beyond the Mississippi. And now, as the naked land spreads out for hundreds of miles on every side, we are awakening to the discovery that the trees have a positive value. As the settlers on the plains of Kansas or Dakota feel the blasts coming down upon them from the Arctic zone, the "blizzards" that thrust their icy darts to the very vitals of man and beast, they long for the trees to stand between them and the deadly storm. The few belts of them that are found along the courses of the streams are like protecting ramparts in the way of a besieging foe. Happy those who are near enough to take advantage of them! Then, too, in an economic point of view, for fuel and for lumber, to be used for construction purposes, how valuable have the trees become! Moreover, as the demands of these vast and rapidly peopling prairies draw heavily upon the forests that are

yet left around the Great Lakes, we are making the discovery that, having already swept away the forests of the Eastern States, the present draft from East and West together upon these lake forests is rapidly extinguishing them, and with them our last resource for a species of lumber which serves, as no other does or can, for the thousand purposes of domestic and industrial life. More than this. As we look back over the path by which we have reached our present position, and see what we have done, and notice the changes which have taken place in our condition, we are discovering also that the trees have an intimate connection with climate, with temperature and moisture, with the distribution of rainfall, and so with the success of our agricultural industry.

We are finding likewise that the forests are closely connected with floods and droughts, and so have a direct relation not only to agriculture, but to commerce and manufactures as well. And so the despised forests, of which we have thought, the sooner out of the way the better, now that they are so nearly out of the way in many parts of the country, are coming to have

in our esteem somewhat the position of importance which belongs to them, and we are beginning to ask, when almost too late, How can we save them, or how can we replace them where they have been destroyed?

A new word, *forestry*, formerly a mere dictionary word, and hardly that even, has come into our common daily speech. An association of those who have been most thoughtful in regard to the office and value of the trees has been formed under the name of a "Forestry Congress," and "Schools of Forestry" and "Forestal Experiment Stations" are under consideration.

These things indicate a change of sentiment in respect to trees, a revulsion of feeling in regard to them and our treatment of them. It has come none too soon. We were on the way to meet great loss and suffering in consequence of the manner in which we have treated our forests. We were on the way to meet the evils which have befallen many of the European nations as the result of the destruction of their forests. Happy shall we be if, through our greater activity and readiness to apply appro-

priate remedies for evils when they are made known to us, and warned in part by the experience of those nations, we adopt measures which give promise of relief from the threatening danger, or at least a mitigation of the evils naturally consequent upon our previous conduct.

History shows that the inhabited world has been characteristically a tree-world—a world peopled by trees as well as men, and science teaches us that the world is habitable by man only as man and the trees hold it by joint occupancy. The trees preceded man on the earth as a prerequisite of his existence here and a preparative for it. It was their office to eliminate from the atmosphere of the early world the deleterious gases which made it irrespirable by man, and it is their office now to maintain that balance between its constituent elements upon which man's health and vigor depend. Chemists and physiologists show us that plants are continually absorbing carbonic-acid gas and pouring out oxygen, or vital air as it was formerly called, because it was regarded as having an indispensable connection with life.

It has been the conclusion of scientific inves-

tigation also that from one fourth to one third of the earth's surface needs to be appropriated to tree or plant life, in order to maintain the best conditions of human existence. Such an amount of wooded surface, while it would preserve the atmosphere in the best state for man's use as a living creature, would also secure to him the amplest returns from the cultivation of the soil, and the largest rewards of his varied industries. In proportion as this balance of natural forces is preserved, agriculture, commerce, and manufactures all flourish best. A due measure of forest not only maintains the atmosphere in the best condition to be breathed by man, but by its continual growth, if that growth is wisely husbanded and protected, is able to supply him perpetually with fuel and the material upon which the larger part of the arts and industries of life depend.

But throughout his history man has been found a disturber rather than a maintainer of the beneficial arrangements of Nature in his behalf. In almost all parts of the world which he has inhabited, man has swept away the trees to such an extent as to destroy the balance of

forces and bring ultimate injury upon himself. In many cases he has been obliged to flee from the desolation which his own reckless action has produced. He has often changed a garden into a desert, and has been compelled to migrate to new regions in order to preserve his life. And where evil has not come upon him to such an insupportable extent, he has been obliged to maintain his life under less pleasant conditions, and attended with burdens and hardships which otherwise might have been avoided. The Old World is full of illustrations of this.

We have been pursuing the same course. But it is only recently that we have begun to see and feel the evils which are threatening us. Our forest wealth was so great, in many parts of the country it is still so ample, that it is only within a few years that our attention has been drawn to the connection between the presence or absence of trees and our personal and national welfare. It has been noticed that many of our streams have been gradually diminishing in volume. It has been noticed also that their flow has become less uniform, that floods have become more frequent, and that as these have

increased, so, on the other hand, the streams have often shrunk away to mere threads, so that they could not be depended upon at certain seasons of the year for the supply of mills, or for the purposes of husbandry or navigation. But we have failed until now to trace these effects to their simple and sufficient cause, the removal of the trees.

The connection is easily shown. Every one acquainted with the forests knows that the leaves, falling from year to year and gradually decaying, form a soil quite different in texture from that in the open ground. It is loose and spongy, and often of great depth. In the Adirondack woods the "spruce-duff," as it is called, is often four feet deep. The rain which falls upon this soil does not flow off immediately, as does that falling on a hill-side bare of trees, but is absorbed by it, as water is absorbed and held by a sponge, and oozes out gradually, flowing down the slope with a steady stream or sinking slowly into the deeper earth to reappear in neighboring or more distant springs. So, again, where forests crown the hill-sides in the cooler latitudes, the snow which falls is screened

from the action of the sun and dissolves slowly, remaining to a considerable extent long after the snow has disappeared from the open fields. Thus a protracted and steady flow into the brooks and streams is secured.

But when the forests along the heads and courses of streams are cut off, the first effect is to dry up the spongy soil, and then to remove it by the combined influence of the sun, wind, and rain. The consequence is, that the water resulting from rain or the dissolving snow flows down the hill-sides at once, and often causes the streams to become torrents, overflowing their banks and carrying disaster and destruction far and wide.

For the same reason, when summer comes, with its lessened supply of rain and more rapid evaporation, there is no reservoir upon the hills as formerly to send its steady flow along the water-courses, and so the streams shrink to brooks, and the brooks to mere threads perhaps. The mill-wheels stop, or must be turned by the power of steam. The boats of commerce can not move in their accustomed channels, or are delayed; and so the many industries of life are

disturbed, the course of trade is disarranged, and great inconvenience and loss result.

Now, this is the condition of things at which we have arrived. These evils already beset us, or are threatening us, in a large part of our country. And thus we have the answer to our first question, *Why* to plant? It is, comprehensively, that we may, if possible, restore the lost balance of the forces of Nature, and thus regain the former conditions of life, or at least mitigate the evils which have already come upon us, and lessen, if we can not check, the greater evils which threaten us. The question is one that concerns not certain individuals alone, but is of national scope and interest. Whatever special answer the peculiar circumstances of any one may move him to give to the question, our common interests as a people and our common needs suggest a ready and pertinent answer to the question for every intelligent person among us. The dweller upon the treeless plains of Dakota, or the valleys of California, may be moved to plant by different considerations from those which urge the resident in Ohio or Vermont; but, dwell where we may within the boundaries

of our great country, we are all interested in the maintenance of an ample supply of trees. We are all interested in the preservation of them to a proper extent where they now exist, and in establishing them in due measure, by planting, in those parts of the country from which they have been removed, or where hitherto their growth has been prevented.

II.

WHERE TO PLANT.

If the condition of things is as we have set it forth, the answer to this question is readily suggested.

The urgency of the case on the exposed plains beyond the Mississippi, and in the arid districts between that river and the Coast-Ranges of the Pacific, will draw our attention to those parts of the country first and lead us to say at once, plant there if possible. How far it is possible to make tree-planting successful in those regions is a matter of dispute. Into the grounds of that dispute we do not propose here to enter. In a simple, practical manual, such as this is designed to be, it is not called for. But the urgencies of the case are such that no reasonable effort should be spared in the endeavor to supply those naked regions with an adequate amount of

trees. People ought not to be invited to live, they ought not to try to live, in such a region as Northern Dakota or Minnesota, unless they have the hope of a speedy change of their condition, to be supplied by the presence of trees. A high civilization would be impossible there without the aid of trees. Barbarism would not only be "the first danger" but the inevitable result. Wheat-fields are not enough, even if droughts and floods could be insured against. "Man shall not live by bread alone." Years ago, a professor in one of the colleges of that region said publicly that it was simple cruelty to invite people to settle there until measures were taken to plant trees so as to make an effectual safe-guard against the terrible blizzards which sweep down from the icy North with such blinding and destructive power. Tree-planting is almost a first necessity of life there. The man who settles there should understand that he is to be engaged in a battle with the icy bayonetry of the North, and he needs at once to raise his breast-work of trees and fight behind their cover. An outlay for these is as needful as an outlay for agricultural implements. With the first turning

of the sod in preparation for wheat-sowing, there should be some turning of the sod for tree-planting. The two should go together. It is important on all accounts. The wheat-fields themselves will be the more productive for the sheltering and salutary influences of the trees.

Trees are equalizers of temperature and moisture, and tend greatly to secure uniform returns to the labor of the husbandman. This is now getting to be well understood, and many are planting trees liberally and with the most satisfactory results. Nature has provided quick-growing trees, which, on the rich soil of the prairies, soon spring up into groves that relieve the nakedness of the landscape, while they bring abundant comfort to the dwellers there by their grateful shade and shelter, and their supply of fuel and timber. In the older prairie States a very manifest change has already been wrought. It has been found that those States were bare of trees, not because there was anything in the soil or climate which forbade their growth, but from other though perhaps unknown causes. Evidences of former tree-growth have been met with. Remains of ancient trees

have been discovered on turning up the soil. Once stripped of their tree-covering, by whatever cause, the annual and unimpeded fires which have swept over those plains were sufficient to prevent any subsequent growth. But since settlers have come in and checked the course of the fires by their barriers of plowed fields, and by their watchful care, it has been found that trees will grow wherever they are given a chance to grow. They have been successfully planted far beyond what many have assigned as the natural limit of tree life. The growth of trees, as of all plants, is dependent upon a due supply of moisture. As we go westward from the Mississippi, there are natural causes which diminish the amount of rainfall in proportion as we approach the Rocky Mountains, and it has been held that from about the one-hundredth parallel of longitude the amount of rain is so small that trees could not be made to grow, except sparsely just along the margin of streams, unless by the artificial aid of irrigation. But, happily, experience has proved that the field of tree-growth reaches farther west than many have been willing to allow. In West-

ern Nebraska and Kansas, there are now growing large groves of trees which the settlers have planted, and, as the latter have taken pains also to check the prairie-fires, the lines of native trees along the water-courses have begun to spread, so that it is estimated that the area of spontaneous tree-growth is half as great as that resulting from planting by the settlers.

There is reason to think we have taken too despondent a view of the practicability of growing trees on the remote plains of the West. While their growth is dependent upon moisture, and can not be established or maintained without it, the trees are equalizers and husbanders of moisture. When planted in masses, they shade the ground and prevent evaporation from the soil from being as copious and rapid as it would be under the undiminished influence of the sun and winds. There is hope, therefore, that we may be able gradually to push the tree-line much farther west than we have formerly supposed was possible, and that, with the help of irrigation in the most arid regions, we may reclaim for human uses and comfort a large part

of our country which has been regarded as a hopelessly barren waste.

There is no need of urging the necessity of tree-planting in all that region. Every settler there, every traveler even who passes over it, must feel the desirableness of establishing a tree-growth there as soon as possible.

But while the need of planting trees seems most urgent on the naked and exposed plains of the West, the need in other places is unquestionable. On most of the hill-sides and mountain-slopes of the North and East or of the Pacific States from which the original forest-growth has been removed, an effort should be made to restore it. There are found the sources of the streams, important to us on so many accounts, and the lessened flow of which has been deplored, while hitherto we have not known how the evil might be remedied. The higher and steeper hill-sides are of little value for agricultural purposes because they are so difficult of access. Often they are so rocky that they are intractable, while the soil is so thin and so liable to be washed away by the rains, that they offer little promise of

reward to the cultivator. Such lands are the appropriate home of the trees. Once planted there, and protected from the invasion of fire and the incursion of cattle, they will grow and produce an ample harvest with little further care or labor on the part of their owner. In a pecuniary point of view these rocky and often precipitous hill-sides can be made so valuable in no other way as by giving them up to the growth of trees. One crop of this kind, requiring almost no care, will ordinarily sell for more than the combined crops of grain or roots that could be raised upon the same ground during all the years that the trees would require to bring them to maturity. With the increase of our population, and the consequently increasing demand for wood for use in the arts and manufactures all the while extending, for building purposes and for fuel, the value of forest property can not but greatly increase.

There is ample reason, therefore, for endeavoring to reclothe with trees the hill-sides from which the forests have been taken. In some cases the reason for planting is as imperative almost as it is on the exposed plains of Da-

kota. On the slopes of California and Nevada, for example, the removal of the trees, which has taken place with such rapidity, is threatening great disaster to those portions of the country. Fires have been allowed to ravage the forests with hardly any effort to prevent or to check them. And, as though this were not enough, the young growth that springs up is destroyed by the flocks of sheep which are turned loose in it for pasture; and even the mature forest is often fired and consumed in order that grass may take its place for the support of the sheep which can not find adequate pasturage in the dry valleys and plains below. This very destruction of the woods, by lessening and making more irregular the flow of the streams, renders the irrigation of the dry plains below less practicable, and without irrigation they are nearly if not quite worthless for all agricultural purposes. Sparsely wooded at the best, and needing every encouragement to make good the deficiency of trees if possible, California has lost one fourth of her forests during the brief period since she became one of the States of our Union. If there is any one duty

pressing upon that State and upon some of the neighboring States, in view of their future needs, in view of their future safety one may say, it is to take the speediest and the most effective measures to preserve what forests they have from destruction, and to encourage the planting of trees on the denuded hills and in the lower plains wherever they can be made to grow. Sheep are not comparable to the forests in value. If those Pacific States lose their forests, they will no longer be desirable, hardly possible, habitations for men; and how much better is a man than a sheep!

But, besides the hill-sides and mountain-slopes, which are the proper homes of the trees, and where the forests, if allowed to grow, are sources of manifold blessings to the country, protectors of its health and its most precious industries, there are other places which invite the tree-planter's attention. On the lowlands there are many stony, sour, sandy, or otherwise sterile tracts, of more or less extent, which are properly called waste-land. They are of little value in an agricultural point of view, but, if covered with trees, would not only have an ap-

preciable worth in themselves, but would be the source of great benefit to the country at large. Many, if not most of these tracts, were formerly covered with forest-trees, and only require to have cattle excluded from them for a few years, when a new growth of trees would be found to spring up. Cape Cod, now to so large extent a barren mass of sand, we have the best authority for believing, was, at the beginning of our history, a densely-wooded region. Other sand-barrens, in all parts of the country, either have the stumps of trees remaining upon them, or were clothed with trees within the memory of those dwelling near them. These now worthless lands can be made to rank with the most valuable, if devoted to the growth of trees.

Happily, this is not a matter of mere theory or opinion. The experiment has been tried, and with abundant success. Hundreds of acres on Cape Cod have been planted, and trees thus planted have now attained a height of forty and fifty feet. The people of that region sow the pine-cones upon their sandy fields with as much confidence that a crop of trees will spring from them as the man who plants corn on the prairie

of the West has that his seed will produce a harvest. On the western coast of France vast districts of barren sand have been reclaimed by planting, and where formerly was an uninhabited desert are now populous villages; while from the pines by which the wastes were reclaimed a large revenue is annually derived through the manufacture of turpentine, as well as by the sale of trees for timber and fuel.

The pines will flourish on poor and sandy soils, though they do not refuse to grow on such as are fertile. And we have no wood at present more valuable than the pine, or one which for years to come will have a greater marketable worth. The white pine, especially, enters into more uses of ordinary life than any other wood. Formerly it was so abundant in our Northern States, from the St. John to the Mississippi, that we hardly noted its peculiar and surpassing value. The supply was at hand, and seemed inexhaustible. So we cut and consumed unsparingly, recklessly even. We consumed not only to meet our own wants, but for the wants of the world.

But at length we have found a limit to the

supply of this valuable wood, and with that discovery its market price has greatly increased, and will inevitably increase yet more. The man who has a growing forest of white pine has a mine of wealth surer than the ores of the Western mountains, and the man who now plants this tree on his useless fields of sand or on some rocky hill-side, called perhaps a pasture, but where the stones will hardly allow the cattle to get their teeth to the grass, if he does not live to reap the sure harvest, will leave to his heirs a legacy as valuable as stocks or bonds.

It would seem that this needs no arguing. But, to show that practical experience bears out all that we have said, we will adduce some testimony from actual tree-planters. Tree-planting in masses, designed to produce forests, has hardly been undertaken in our country until quite recently. Among the earliest to engage in this work were the Messrs. Fay, in Essex and Barnstable Counties, Massachusetts. They have been followed by several persons on Cape Cod. Mr. R. S. Fay began a plantation on his estate, near Lynn, in 1846. In that and the two following years he planted two

hundred thousand trees which he had imported, and subsequently as many more raised by him from the seed. These trees occupied about two hundred acres. The land which he planted was of poor soil, stony, exposed to the wind, in short, good for nothing else, but in this respect like not a little of the land in the northern part of the country, especially in New England. A variety of trees was planted, such as oaks, ashes, maples, the Norway spruce, the Scotch and the Austrian pine, but principally the European larch. Twenty-nine years after the trees were planted, according to the testimony of Prof. Sargent, of Harvard University, who made a personal inspection of the plantation, some of the larches were more than fifty feet in height and were fifteen inches in diameter, three feet from the ground. Other kinds of trees had grown to a height of forty feet. During the ten years immediately preceding his visit, seven hundred cords of fire-wood had been taken from the plantation, besides all the fencing required for the large estate, and Prof. Sargent says that, at the time of his visit, fire-wood, fence-posts, and railroad-sleepers, to the

value of thousands of dollars, could have been cut to the manifest advantage of the remaining trees. Can any one doubt that Mr. Fay's stony, sterile acres were put to a profitable use?

A somewhat similar experiment was made by a brother, Mr. J. S. Fay, on the southwestern portion of Cape Cod, on a tract of land about one hundred and twenty-five acres in extent. It is now densely wooded, but when planted was as forbidding, perhaps, as any land to be found. It was fully exposed to the cold northwest winds in winter, and to the fierce gales of the Atlantic and their saline moisture, so hurtful often to tree-growth. As to the character of the land, Mr. Fay says: "My land is made up mainly of abrupt hills and deep hollows, sprinkled over with bowlders of granite. The soil is dry and worn out, and what there is of it is a gravelly loam. The larger part consisted of old pastures, and on the one hundred and twenty-five acres not a tree of any kind, unless an oak, that sprang out of the huckleberry-bushes here and there, barely lifting its head above them for the wind, and, when attempting to grow, browsed down

by the cattle ranging in winter, could be called a tree. . . .

"Thirty-five thousand trees were imported and set out, besides a large number of native trees procured in this country; but fully three fourths of the whole plantation was made by sowing the seed directly on the ground where the trees were to stand. A large variety of trees, both native and foreign, were employed, and while few have failed entirely, the foreign species, as was to be expected from the situation, have been the most successful. Larch and Scotch pines, transplanted from the nursery in 1853, are now (1875) forty feet high, and from ten to twelve inches in diameter at one foot from the ground. Trees of the Scotch pine, raised from seed planted in 1861, where the trees have grown, but in favorable situations, and which have been properly thinned, have been cut this winter, and measured thirty feet in height and ten inches in diameter one foot from the ground, while the average of the trees in a large plantation of Scotch pine, made in the same manner in 1862, and which has received no special care, is twenty feet high and six inches in diameter."

Instances of a much more rapid growth, on the rich soils of the West, might be adduced, though not reaching over so long a period of time. But we have chosen to take illustrations such as the above, as showing not only a tree-growth satisfactory in itself, but the additional fact that land, poor and otherwise unremunerative, may thus be put to profitable use. Further, it ought to be taken into consideration that a plantation of trees is not only profitable in itself, but that, if rightly disposed, it makes adjacent lands more valuable. In regard to many if not most farms in our country, it may be said with confidence that if from a tenth to a sixth part of their area, on the sides most exposed to winds, were devoted to a growth of wood, the protection thus afforded to the growing crops would increase their yield by a large amount.

It is to be remembered also, when considering the economic aspects of forestry, that trees are not an exhausting crop, but on the contrary, by the accumulation and decay of their leaves, falling from year to year, they serve to enrich the ground where they grow. On

this account a barren, sandy, and practically worthless soil for the ordinary purposes of tillage may be so reclaimed by the growth of trees as to be fitted to produce other crops when the trees are cut off, or, if retained as woodland, to give a more rapid and vigorous growth of trees than before. The effect of the larch in enriching the ground is quite remarkable. A writer in the Scotch Highland Society's "Transactions" cites the case where the pasturage under a plantation of larches thirty years old, and which had been thinned to four hundred trees to the acre, produced an annual rental of eight or ten shillings the acre, while the same land, previous to the introduction of the larch, was let for one shilling the acre. Grigor, an eminent English authority, says: "No tree is so valuable as the larch in its fertilizing effects, arising from the richness of the foliage which it sheds annually. In a healthy wood the yearly deposit is very great; the leaves remain and are consumed on the spot where they drop, and, where the influence of the air is admitted, the space becomes clothed in a vivid green with many of the finest kinds

of natural grasses, the pasture of which is highly reputed in dairy management."

Prof. Sargent has endeavored, from the examination of Mr. Fay's plantation, to make a practical estimate of the profit of tree-planting. He says: "I think we can feel confident that on the ordinary soil suited to their culture, larch, planted when about one foot high and three years old, will in twenty years average twenty-two feet in height and seven inches in diameter, three feet from the ground; and that in thirty years they will be from thirty-five to forty feet high and twelve inches in diameter; and if the plantations are thinned to four hundred trees to the acre, that at the end of twenty years more, or fifty years from the time of planting, the trees will reach from sixty to seventy feet in height and at least twenty inches in diameter. This is also the average growth of this tree in the Highlands of Scotland, under nearly similar conditions.

"Let us consider what profits a plantation of larch, ten acres in extent, and intended to stand for fifty years, would give. The labor of cutting the trees will be more than paid for by the

sale at different periods of a large amount of small wood suited to many rustic purposes, but for which no credit is made. It must also be remarked that the following account is charged with a permanent wire-fence, although it is more than probable that any land suited to this purpose is already surrounded by stone walls, which would require but little subsequent care. Present prices for forest products are taken, without allowance being made for their probable future increase in value.

Estimated Profits of a Plantation of European Larch of Ten Acres, to last Fifty Years.

Dr.

Ten acres of land, at $20	$200 00
Wire fence	1,000 00
Plants, 27,250, at $5 per 1,000	136 25
Labor of planting	500 00
	$1,836 25
Interest on investment as above, 50 years, at 6 per cent	5,499 00
Taxes, 50 years, at 1.5 per cent	150 00
Interest on taxes equal 25 years, at 6 per cent	225 00
	$7,710 25

Cr.

Product of first cutting, at the end of 20 years: 13,000 trees, less 20 per cent for casualties = 10,400 trees, or 20,800 fence-posts, at 20 cents		$4,160 00
Product of second cutting, at the end of 30 years: 10,200 trees, less 10 per cent for casualties = 9,180 trees, or 18,300 sleepers, at 50 cents,	$9,180 00	
And 9,180 fence-posts, at 25 cents	2,295 00	
		$11,475 00
Product of third cutting, at the end of 50 years: 4,000 trees, less 5 per cent for casualties = 3,800 piles, worth $5 each	$19,000 00	
And 7,600 sleepers, worth 50 cents	3,800 00	
		$22,800 00
Land at cost		200 00
		$38,635 00
Thirty years' interest on $4,600 at 6 per cent	$7,488 00	
Twenty years' interest on $11,475, at 6 per cent	13,770 00	
		$21,258 00
		$59,993 00
Profit		$52,282 75

"Equal to about thirteen per cent per annum for the entire fifty years, after returning the original capital invested.

"There is no branch of agriculture at once so pleasant and so productive of possible gains as farming on *paper*. It is a dangerous pastime, however, and often leads into grave errors and great dangers, as the agricultural population has learned to its cost. In this case it will be well to be on the safe side. The larch, in common with other plants, is liable to disease; it is preyed upon by many insects, and our plantations may be often injured by fire, bad management, and other dangers now unforeseen.

"In view of such chances, let us reduce the total yield of our ten acres of larch a little more than one half, and be content with a profit of only six per cent per annum on the capital invested."

Such a diminution would leave us, in round numbers, $24,000, as the profit of the ten acres.

Many estimates of the returns of tree-planting, made by those living on the fertile soils of the West, promise a much larger profit than that supposed by Prof. Sargent. But whatever

deductions any may be disposed to make from one estimate or another, it admits of no question but that a fair and satisfactory remuneration awaits the tree-planter who engages in planting with reasonable skill and proper attention to the business.

In answering the question "Where to plant?" the railroads ought not to be passed by. They are great consumers of forests, both for fuel and for their very construction, and although the increased price of wood, arising from the diminution of the forests, has led to the increased use of coal for fuel in place of wood, the demand upon the forests for railway-ties is enormous and all the while increasing. We have now at the lowest calculation, including second tracks and sidings, 150,000 miles of railroad track. Every mile has required from 2,200 to 3,000 ties. It will not be in excess of the truth if we make the average demand 2,640. We have then 396,000,000 used in the construction of our railroads. But railroad-builders choose for their use young and vigorous trees, trees that have not half reached their maturity, and are only large

enough to make one tie to a cut and only two or at the most three cuts to a tree. Two will probably be the average. The building of our railroads, therefore, has consumed 198,000,000 trees, and those cut off when, if left a few years longer, they would have made a more rapid increase in bulk than they had done in their younger life. It is a generous estimate that allows fifty such trees to be found on an acre of woodland. We have, then, 3,960,000 acres of forest stripped of their most valuable trees in the construction of our existing railroads.

But this is not all. Railroad-ties last, on an average, seven years. To keep up the equipment of our roads, therefore, requires every year 56,571,428 ties, in addition to what are demanded for the construction of new roads, or the product of 565,714 acres. So that if the railroads would keep themselves good, as it requires thirty years to grow trees large enough to make ties, they need 16,971,420 acres devoted to their growth, or 113.3 for every mile of their length. It may well be considered, therefore, whether the railroad companies should not become forest-planters as a matter of self-interest.

Especially may this be urged, when we regard the trees not only as a source of supply for the renewal of the road-bed, but also as a shelter from sweeping winds and a preventive of impeding snows, often such a hindrance and source of expense. We have it on the authority of the superintendent of the Northern Pacific Railroad, that the removal of obstructions by snow on that road during the winter of 1882–'83 cost not less than $100,000, and he estimates that by planting a shelter-belt of trees along the line of the road, at a cost of one fourth that sum, a permanent protection from impeding drifts may be secured. The work has already been begun. Some other Western companies are doing a like work, and where, as in so many cases, they have such ample grants of land as have been given them, there would seem to be no good reason why they should not only plant shelter-belts along their lines, but devote sections enough to the growth of forest-trees to supply in the not distant future all their needs for ties. By so doing, they would not only promote their own interests and the comfort of travel, but would be doing their part to secure

for the region through which they pass those ameliorating climatic influences and those beneficial effects upon agriculture which forests are adapted to produce.

Finally, we name, not so much on the score of profit or advantage, as of comfort and taste, our common roads and the streets of our cities and villages, as appropriate places for the planting of trees. What else is there that gives such a charm to many of the villages in the older parts of our country, and especially to many of the New England villages, as the lines of noble, graceful trees which border and often overarch their streets, and whose beauty every one sees and feels? The beauty and charm are so manifest to the dullest nature almost, that as population has spread into newer regions, road-side planting has been often repeated. In many cases, however, there has been neglect in this particular, and in all parts of the country there are places where, by a comparatively little expense in planting the proper trees along the street-borders, villages and towns now unattractive and even forbidding in appearance, perhaps, would be transformed into inviting places

of residence. The whole tone of society would be perceptibly improved in a few years, as, following the appearance of the trees, one change after another would come in for the better.

But why should not the highways that lead from village to village and from town to town have pleasant borders of trees as well as the village streets? How pleasant would be their screen from sun and wind oftentimes! What a preventive of the annoyance of dust, and how grateful to the sight their varied forms of grace and beauty! In some European countries the planting of trees by the road-side is made obligatory by law.

Usefulness is combined with beauty also, by choosing fruit-bearing trees for road-side planting. We might well follow the example of those countries in both these respects. What beautiful forms do many of our fruit-bearing trees have, as, for instance, the cherry and the pear, or the hickory and chestnut! And let us not suppose that, if trees of this class were made thus abundant, so that the passer-by might be free to help himself for his present satisfaction, our people would not be as easily restrained

from plundering or injuring the trees as are the European populace. In proportion as fruit is abundant, the temptation to plunder is lessened. Put people on their good behavior, and you increase their self-respect, and with that their respect for the rights of others.

III.

WHAT TO PLANT.

No general and comprehensive answer to this question can be given. The answer in any particular case will be determined by the special object one has in view in planting, and also by the character of the climate and soil where the trees are to grow; in part, also, by the personal preferences of the planter. If one is planting for the purpose of securing the best return of timber or lumber from his forest, he will, very properly, plant a different class of trees from what he would choose for the purpose of making a wind-break or to add their charm of beauty to a lawn. If the land which he proposes to devote to the growth of trees is of a light, sandy character, his selection of trees will be different from what it would be if the soil were a deep, rich

loam. A dry soil will favor a different class of trees from one that is moist or wet. Some trees will bear exposure to winds better than others. Some will bear a temperature that others will not. A variation of a few degrees of the thermometer is sufficient to decide the question of success or failure in planting many trees. Some, again, are of slow growth as compared with others, in themselves of equal value. Some have a symmetry of form that others have not, and may be preferable on this account. Some, by their structure, are better adapted to use in the arts than others. All these considerations are taken into account in deciding in any given case what to plant. Success depends upon it.

Native Trees.

But while each one must answer for himself the question, What to plant? it is safe advice to the inexperienced tree-planter, and may be very serviceable to him, when we urge him to plant *native* trees. By this we mean not simply those that may be found growing freely

in some part of our own country, in distinction from those whose native home is in other lands, but we mean those which are found growing spontaneously in the particular region where the proposed planting is to be done. It is always safe to follow the indications of Nature. If one is at a loss how to commence the work of tree-planting, let him look around him or in the region nearest him where trees are growing and have come to maturity without the aid of man. He may be sure that it will be safe for him to plant such trees. These are what Nature certifies to him are adapted to the conditions of soil and climate which exist where his lot is cast. He may be where trees are few at the best. He may be on the prairie, and where, perhaps, the annually recurring fires have kept down almost all arboreal growth But here and there, along some stream, he will find a few trees, at least, lifting themselves up, to show that trees are possible. Let him be encouraged by this sure indication. Let him gather the seeds of these trees, or take sprouts from them, and plant with confidence. They may not be trees of the most valuable

class, possibly. They may not be the most desirable for timber. They may not be century-growing oaks. But they are the most valuable trees for him for present use, because they have the certification of adaptability. They are on their native ground. Let him begin with these. Then, if he chooses to experiment with others afterward, or even in connection with these, let him do so. The first necessity of the dweller on the naked prairie, or any place bare of trees, is to get whatever tree will hide, in part at least, its nakedness. He wants to begin with a screen about his house, something that will stand between him and the freezing and scorching blasts that by turns sweep by, and he wants something to shut him in a little from the boundless sea of space around him and give him a sense of locality and neighborhood, some companionship close at hand, if it be but the companionship of trees. And there is a deal of companionship in them. There are "tongues in trees," as many others know, as well as Shakespeare.

And so, also, the man thus situated wants sheltering belts, or stretches of trees, for his

cattle and his crops. He needs wood for fuel and for fences as soon as may be. Nature points him to the cottonwood and the willow, not far away, with their rapid growth, and with these his immediate and most pressing wants are met. And while these are his dependence for present effect, there are other trees in great numbers offering themselves to his use as he looks for more distant, and, in a sense, more valuable results.

Our country is wonderfully rich in its varieties of trees, and there are valuable ones adapted to every portion of it. At our Centennial Exhibition at Philadelphia, more than four hundred native species were shown. Prof. Brewer estimates that we have as many as eight hundred species of woody plants indigenous to the United States. Two hundred and fifty of these, and which grow to the height of thirty feet, are abundant somewhere in our country. We have a hundred and fifty species of trees of larger size, of which fifty are of the coniferous class. Twenty species grow to a height of more than one hundred feet. Twelve species attain a height of two hundred feet. Five

or six gain a height of more than three hundred feet. We have thirty-eight species of the oak, and five of the ash, second only to the oak in value. There are not more than fifty species of forest-trees in all Europe worth cultivating.

Out of this great variety of trees with which our country abounds, there is comparatively little difficulty in finding valuable kinds adapted to almost any situation. There are the maples and birches, the beeches and elms. There are the walnuts, black and white, the latter more commonly known as the butternut. There are the hickories, peculiarly American trees, and for which there is a great demand in Europe as well as in our country, for uses where strength and toughness are needed. There is the chestnut, quick growing and useful for so many purposes, and whose fruit by cultivation would be made to exceed that of the Spanish in size and value. There are the tulip, or white-wood, and the bass, or linden-trees, and the sycamore and the various gum-trees, with the hackberry, the cherry, and the locust. And then there are the fifty species of cone-bearing trees, the pines, spruces, and

larches, so valuable both for lumber and for their resinous products, as well as for screens, and for their cheering beauty in the season when the deciduous trees have dropped their foliage.

We can not, within the compass of a volume like this, speak in detail of the long catalogue of trees which offer themselves to our hand for planting, and which, for one purpose or another, are valuable, and commend themselves to the attention of the planter. We leave that to the special treatises on the subject, and confine our remarks to a few trees which are worthy of almost universal consideration.

One who is contemplating planting on a considerable scale, can hardly go amiss in making use of the oak, in one or more of its varieties, a tree which, as far back as history goes, and among so many nations, has been recognized and cherished on account of its many valuable qualities. For fuel and for timber, for building and for many purposes in the constructive arts, it easily ranks as one of our most valuable woods, if it does not stand clearly at the head of the list. And already the alarm is sounded that this tree, so common, so well known, growing

throughout such a wide range of latitude and longitude, is becoming scarce. By this is meant the finer specimens, the sound and well-ripened trees which will make the best grade of timber or furnish lumber fit for the uses of the carpenter and cabinet-maker. European agents are constantly searching our forests in quest of this tree.

The oak, if the king of trees, grows slowly, and, though valuable for some purposes at all stages of its growth, only reaches the maturity of its strength and its greatest value with the lapse of centuries. Oaks and beeches grow well together, as the roots of the former penetrate the ground deeply, while those of the latter spread upon the surface. In our reckless treatment of the forests hitherto, our best trees have been destroyed for the commonest purposes, sometimes only to get them out of the way. Quite early in our history, fear was excited on this account, lest there should soon be a scarcity of the oak of a quality desirable for ship-building. But we have continued our reckless consumption until some species of trees have become well-nigh extinct, and it is only with diffi-

culty that fine specimens of others can be obtained. The steady increase of the market-price of almost all our woods, and the rapid increase of that of some, is the sufficient proof of our wasteful use of the forests without having made any provision for their renewal.

The most valuable of our forest-trees is, unquestionably, the white pine (*Pinus strobus*). While it can not take the place of the oak or of some other trees for particular purposes, we have no other tree which meets our need for so many uses as this does. It combines strength with lightness as no other wood does. Hence it is in great demand for the masts and yards of vessels. It enters into the construction of our buildings of every kind as no other wood does. It long ago took the place of the hard-woods, such as the oak and the chestnut, for the frames of buildings and for floor-beams. On account of its being so easily worked by the tools of the carpenter and cabinet-maker, in this respect surpassing all other woods, it has been almost universally used for the outside covering and the interior finishing of buildings, and for the construction of a multitude of articles which minis-

ter to the necessities or the conveniences of life. So extensive and so multiform has been its use, that in those parts of the country where it has abounded, it has been almost the one tree known and used. And so desirable is it, on account of its peculiar qualities, that it has been carried in great quantities far beyond the regions of its native growth.

The proper home of this tree is in cool latitudes or on the high hills. At the settlement of this country a belt of this timber stretched from New Brunswick on the east to the Mississippi River, and along the Alleghany Mountains as far south as Georgia. Maine has been known as the Pine-Tree State, on account of the almost exclusive prevalence there of this tree and the kindred spruce. The value of the white pine is shown, and its adaptability to many uses, when we find that, owing to the demand for it, the forests of Maine have been virtually swept away by the lumberman's axe, enough only being left for home consumption, while the intervening region has been nearly cleared, and ten years more, at the present rate of consumption, threaten to leave nothing valuable of the great

pine-forests of Michigan and Wisconsin. The limited supply of pine has doubled its price within a few years, and will inevitably increase it still more. Whoever has a tract of this wood now growing, has a valuable property, well worth his care and protection; and whoever plants a tract of land with this tree may be sure that he could put his ground to no more profitable use.

The white ash and its kindred species are among the most widely diffused and valuable hard-woods. The ash is commended to the planter by its rapid growth, as well as its substantial qualities. It is one of our most beautiful trees, and eminently adapted for planting on the lawn, or along the street border. But it is also one of our most valuable timber and lumber trees. The wood is in great demand for the manufacture of agricultural tools and machines, for carriage-building, the making of oars, barrels, tubs, and many other things. While it is light, it is very tough and elastic. It is much sought for by cabinet-makers, and is coming into use quite extensively for the interior finish of dwellings. There is a large de-

mand for it from foreign countries. It promises, therefore, to be one of the most profitable trees for the planter's use. It is adapted to the cool climate of our Northern States, but grows from Nova Scotia to Louisiana, and is one of the few deciduous trees found also on the Pacific slope. It is best grown in a cool, deep, and moist soil, and does well when mingled with other trees of denser foliage, as the beech and maple.

The linden, or bass-wood, and the tulip-tree, or white-wood, sometimes also called the yellow poplar—though it is not a poplar—are trees of great value. They have a wide range, being found from Canada to Florida, and as far west as Kansas. As the white pine is becoming scarce, these woods are substituted for it in many cases, especially in house-building. They are extensively used also for the manufacture of furniture, carriage-bodies, trunks, and boxes of various kinds. While light, they are strong and easily wrought, and their use is likely to increase. They are also among our most desirable trees for ornamental planting, whether on the lawn or by the road-side.

With them may be classed the sycamore and the maples, which are at home throughout a wide extent of our country, and offer themselves for a great variety of uses. They are among our most valuable trees for fuel, and, with all our use of lumber in the arts and for building purposes, it is to be remembered that three fourths of the legitimate demand upon the forests is for fuel. In our general estimates of the value and importance of the forests, we perhaps lose sight of their value in this respect. But this, after all, is their chief and commonest use. Coal may lessen the demand upon the forests for fuel, in some places, and for a certain length of time. But the coal-mines are not inexhaustible. Coal does not grow—wood does. The English have already begun to forecast the time when their coal-fields will be exhausted. What, then, will remain for them but to bring their fuel from abroad? And what will be the condition of their great manufacturing industries, when the fuel which drives their machinery has to be brought from afar instead of being mined cheaply at home? Put off the time of the exhaustion

of our immense coal-fields as far as we may, there will come a time of exhaustion. Formerly we thought our forests as exhaustless as we now think our coal-mines to be, and yet we are looking upon an almost naked country where the forests once darkened the land. But if what remains is properly husbanded, and if forests are planted on the hills and on the waste and untillable lands, we can have, for all time to come, all the lumber we need for the arts and for construction purposes, and all the wood we need for fuel, while at the same time we are so maintaining the balance of the natural forces as to secure the highest measure of health and material prosperity.

Not to speak of the particular merits of others of the maple class, the rock or hard maple, known also as the sugar-maple, deserves special consideration. No tree, perhaps, combines in itself more desirable qualities. No tree excels it in beauty of form, in massive solidity of appearance, none in beauty of foliage, especially when it puts on its robes of crimson and gold in the autumn of the year. Then it seems the very monarch of the trees. Its wood

is also as solid as the outward appearance of the tree would indicate. It is of fine texture, adapting it to many important uses, such as the framework of machinery, agricultural implements, and tools of various kinds. It is used extensively in making furniture and cabinet-work. No other wood unites in an equal degree the properties of ease in working, toughness, compactness, and perfect smoothness when exposed to wear. Not unfrequently the peculiarity of its grain gives us the beautiful "bird's-eye-maple," as it is called, or the "curled maple," so highly prized by the cabinet-maker, and contributing so much to the ornament of our dwellings. For fuel this tree is second only to hickory, and for making charcoal it is unsurpassed. But, to all these qualities which make it so valuable, is added the saccharine nature of its sap, which brings it into competition with the cane of the tropics for the production of sugar. On this account it deserves special consideration by the tree-planter. The census reports the annual production of sugar from the maple as 35,576,061 pounds, and 1,796,048 gallons of sirup in addition, equivalent to 20,000,000

pounds of sugar, making a total sugar-product of 55,576,061 pounds. This sugar is of the best quality, nearly identical in chemical composition with the cane-sugar of commerce, but having also a peculiar flavor which makes it a universal favorite. Why should we not avail ourselves of the capability of the maple for sugar-making more than we do? It is estimated that the average product of well-grown trees is from three to six pounds a year, and this without injury to the tree in its final product of timber or fuel. An important industry and source of revenue is here opened. We might produce a quantity of sugar from this source which would materially lessen our outlay for that which we now import at great cost. It would require but a few acres devoted to the growth of the maple to furnish the farmer with an ample supply of this important article of domestic comfort and use. The "sugar-bush," as it is called, might be greatly extended in many parts of our country with manifest advantage, for while this maple combines in itself almost every desirable tree-quality, it has also a very widely-extended range, being found in greater or less

abundance from the forty-second degree of north latitude to Georgia, and from the eastern border of Maine to the Rocky Mountains.

Among the maples the box-elder (*Negundo aceroides*), or ash-leaved maple, is especially worthy of notice, on account of its hardiness and rapidity of growth. For this reason, though it is an inferior tree for lumber, it is valuable for use, especially on the dry and bare plains of the Northwest. Its form and foliage likewise make it a desirable tree for planting by the road-side. It has also a saccharine sap, from which sirup and sugar are made, but its value on this account is not equal to that of the sugar-maple.

Another tree of rapid growth, but of more substantial merit, is the locust (*Robinia pseudacacia*). This tree deserves more attention than it has commonly received. No tree when young is more beautiful, owing to the peculiar tint and shape of its leaves, and the graceful disposition of its long and slender branches, in which it resembles the willows. It is one of the trees to be chosen for planting near the dwelling, especially where it is desirable to get the shelter or companionship of trees quickly. But the locust has

other claims to attention. While it is of very rapid growth, it is one of our most valuable timber-trees. It is compact in structure, close-grained, very strong and durable. No other wood will bear a greater strain. It is especially valuable for fence-posts, resisting decay, when used for this purpose, better than any other wood except the cedar and the catalpa. It has long been sought after for treenails for ships and for the floors of vessels, and it is adapted to many other uses. It is easily propagated, is at home throughout a wide belt of country, reaching from the New England coast to the far West, and will grow in comparatively poor soils. Owing to its peculiar foliage, grass will grow under the shade of this tree more freely than under that of most trees, and cattle may be pastured in locust-woods with comparative impunity to the trees. It has been extensively cultivated on Long Island for a century, and its cultivation has been found profitable. The principal discouragement which the planter meets is the attack of the borer, but in many localities there is comparatively little trouble from this source.

The honey-locust (*Gleditschia triacanthos*), or three-thorned acacia, though a different species of tree, and not equal in valuable qualities to the *Robinia*, or common locust, is yet a substantial tree, and worthy of cultivation.

The elm, of course, will not be forgotten or neglected by the tree-planter. As a single tree on the lawn, or by the side of a wide road, where it has room in which to spread and develop its true character, we have no tree among the broad-leaved or deciduous species equal to it in combined grandeur and beauty. And so it has been a favorite tree for planting by the roadside, dividing favor in this respect with the maple alone. It reaches its best development along the river-valleys of the Middle States and New England. No one who has seen the elms of the Connecticut Valley at Northampton or Deerfield, or who has walked under the overarching elms of Temple Street and Hillhouse Avenue, New Haven, will ever expect to see anything finer in tree-form, or wonder that a city which bears the honor of being the seat of Yale College should also be called the "Elm City."

But the elms, of which we have four species at least besides the white, are all estimable forest-trees, having a high fuel-value, as well as great usefulness as timber for many constructive purposes. Elm is the favorite wood for the hubs of carriage-wheels and for ships' blocks, and is in demand for many other uses. It bears well exposure to the atmosphere. While it grows best in deep, moist soils, it is found in a great variety of situations.

The birches, among the most widely diffused of all our trees, are also among the most valuable, though they have often been underrated because of their very abundance, or because they do not compete with the oak and the pine as timber-trees. But they have a very high fuel-value, and, when we consider that by far the largest and most necessary use of the trees is for heating purposes, we shall feel that this class of trees ought to be cherished by us. They have other qualities, however, which commend them to our attention. For many small articles of manufacture the birch is preferred to any other wood. For spools and bobbins, for instance, and for many articles made by the turner's art, the

white birch is in great demand, and birch-forests are frequently bought by our manufacturing establishments, to the extent of thousands of acres, for the purpose of securing a sufficient supply for such uses. The (in one view) insignificant article of shoe-pegs makes annual demands upon the birch-forests to the extent of many acres, these little helps to locomotion being made very commonly of this wood. The white birch, moreover, has large claims as an ornamental tree. What is finer than the delicate ramification of its limbs, which give it a positive beauty in winter, while in the leafy season the contrast of the white wrapping of its silvery trunk with the prevalent green of grass, and the darker hues of other trees around, sets the whole lawn or landscape into life? Indeed, the birches, as a whole, are among our most beautiful trees.

The beech is another of the nobler forest-trees, carrying a denser mass of foliage than most other trees, while its wood is among the most useful, having a high specific gravity, great value for fuel, and is held in much esteem for many mechanical uses, especially in the manu-

facture of planes, tool-handles, and the like. The fruit of the beech-tree, the beechnuts, or beech-mast is also valuable as food for swine, and in Europe the right of feeding swine in the great forests of beech and oak, or the right of "pasturage," was one of the most valuable rights of the peasantry. In the endeavor to improve the quality and productiveness of the forests in recent times, by protecting the young trees from injury by animals, this has been the most difficult right to extinguish. The peasantry have clung to it tenaciously.

The willows have not received the attention which they have deserved from tree-planters. The weeping-willow, an imported tree, and limited in the range of its adaptability to our soil and climate, has been used to some extent as an ornamental tree on the lawn and as a funereal tree in the cemetery, and we have been accustomed to see other willows growing spontaneously along the water-courses, without regarding them as having any particular value. Their principal use has been as cheap fuel, except where a powder-mill has happened to be near where they have grown, and then the own-

er of them has found it for his advantage to cut off the sprouts, after a few years' growth, and take them to the mill, as the qualities of this wood make it very desirable in the manufacture of powder.

But the willow is a quite valuable tree. Few trees are so easily cultivated or adapt themselves to so many situations. It grows rapidly, and the white or gray willow especially, if allowed to do so, attains a large size. There is one in Stockbridge, Massachusetts, which, at four feet from the ground, measures twenty-two feet in circumference. It is said to have been planted seventy-five years ago. Its limbs spread so as to cover an area of nearly one hundred feet diameter, and they are so large as to admit of seats being constructed among them in the form of a gallery, which is reached by a staircase from the ground, and will contain nearly a hundred persons.

Contrary to the general impression, the willow is not a tree which is confined to low or wet situations. It flourishes equally well upon high ground. In Europe it is highly esteemed as a timber-tree, and willow-lumber is constantly

quoted in the market. It is used much for house and ship floors, and for the frames of buildings. It is light, tough, and elastic. A peculiarity of it is that it does not splinter as many woods do. This adapts it to use for flooring, and for carriage and cart bodies. It is used in the manufacture of bowls, trays, and other vessels, and for turned goods of various sorts. It has also great durability under water or when much exposed to its action. It is very valuable, therefore, for the floats of paddle-wheels and the buckets of mill-wheels.

Considerable attention has been given to the willow of late in the Western States, especially in those which have been lacking in trees, where it has come into use to some extent for hedges and wind-breaks. Its use may well be encouraged on a larger scale. Few trees will yield a supply of fuel and timber as soon as the white willow.

Special attention has been recently called to one of our native trees which we have not mentioned, but which ought not to be passed in silence. It is the catalpa. This tree abounds in the region adjacent to the confluence of the

Ohio and Mississippi Rivers, but is found more or less throughout the Southern and Middle States, and in the lower portion of the Western. How far toward the north it can be successfully cultivated, remains to be proved by experiment. Hitherto it has been classed among the ornamental rather than the useful trees, its large, fan-like leaves and showy clusters of flowers, somewhat like those of the horse-chestnut, making it a very attractive object on the lawn or by the street-side. In its native region, however, it has had a reputation for great durability, especially when exposed alternately to the influences of dryness and moisture. It has consequently been much in request for posts for gates and fences, and specimens have been exhibited which have been thus used for a great number of years without showing signs of decay to any considerable extent. The tree is said to have been a favorite with the Indians for the construction of canoes, because of its durable quality when exposed as canoes are, and because of its not being liable to crack. Latterly it has been much sought by the railroad companies for ties, on account of its durability. It has been so much in

demand that the present supply for this purpose is likely soon to be exhausted. There is an increasing demand for it also for the uses of the cabinet-maker and carpenter, as the wood is of a beautiful color and grain, and takes a high polish, making it valuable for the manufacture of furniture and for the inside finish of houses. With these desirable qualities it combines great rapidity of growth, so that it promises to be one of the most valuable trees for the use of the planter.

There are two species or varieties of this tree, though, until recently, they have been confounded. They are now known as the hardy and the tender, or *Catalpa speciosa* and *Catalpa bignonioides*, and are distinguishable chiefly by their seeds and the time of the appearance of their flowers, the one blooming about a fortnight before the other. The earlier one is the more hardy, and is to be chosen by those planting north of the Ohio.

The railroad companies of the West are wisely turning their attention to this tree, and planting it on a considerable scale in view of their future wants for ties, and others are doing

the same, on account of the promise it gives of pecuniary returns.

Another tree may well be spoken of also in connection with the catalpa, viz., the ailanthus, or "tree of heaven," as it is sometimes called. This tree, originally from China, has become quite domesticated with us. It grows as far north as Portsmouth, New Hampshire. It is of rapid growth, is propagated easily from seeds or cuttings, and attains a height of seventy feet. The wood is very hard and compact, has a beautiful grain, and the tint of fresh mahogany. It is valuable for the cabinet-maker's use. The ailanthus was a fashionable tree formerly, and was much planted in door-yards and on the streets of many of our cities, but the disagreeable odor of its flowers, and perhaps also its disposition to throw up suckers freely, led to its being discarded. But the bad odor of its blossoms pertains to the trees of the male sex only, and may be avoided by a proper selection in this respect. The odor, however, will be no special objection to a tree when it is to be planted not as an ornamental tree, and near the house, but for forest purposes. The ailanthus has a high

value for fuel. Prof. Sargent, of the Arnold Arboretum, commends it in strong terms, and expresses the opinion that we have no tree that promises to give the planter so valuable return in an equal space of time.

An entire and very valuable class of trees, with the exception of a single one which we have mentioned, remains to be spoken of. It is that of the evergreens, or trees which are not stripped of their leaves during any part of the year, distinguished otherwise as the coniferous or cone-bearing trees. As a class they are of a softer texture and less specific gravity than those of which we have hitherto spoken, and which, in commercial language, are known as "hard-woods." But the evergreens are not less valuable than the latter. Indeed, they make up the great bulk of our lumber-traffic, and furnish the largest share of material used in the arts and industries of mechanical life. Nine tenths of the lumber in the market now is probably that of a single species of the evergreens, the white pine. The forests of the Pacific slope are made up almost wholly of the coniferous trees, the red-wood being the principal; and a belt of pines

extends along the Atlantic coast and around the Gulf of Mexico to Texas. Of the white pine we have spoken already. The yellow and pitch pines, though inferior to that, in some respects, are of great value. They do not require so cold a climate or so rich a soil. They are proverbial for growing on the poorest ground, which they tend to enrich by the decay of their foliage as it falls from year to year. On this account the pines may be used to prepare the way for other trees which it is desirable to establish.

In the Southern portions of the country the yellow pine has long had a special value, on account of its yield of turpentine and its associated products. It is also very valuable for its lumber, for some purposes being preferred to the white pine, and, as the latter is becoming scarce, the former is often used as a substitute for it. It is harder than the white pine, and is coming into use more and more for floors, stairs, window-sashes, and many other purposes.

The hemlock, though for the production of lumber it is inferior to the pine or the spruce, is a very valuable tree. It is the most beautiful of

all our evergreens, for while it attains a lofty stature, like that of the pine, its limbs and foliage are more delicate, and the tree has a more graceful appearance. It is recognized as one of the most desirable trees for planting on the lawn. It is one of the best trees also for use in making screens and wind-breaks, and no tree is better for forming hedges, as it bears the shears extremely well. Though it does not produce lumber of the first class, yet where it is not exposed to the weather, as when used for the sills and rafters of buildings or for lining-boards, hemlock-lumber is strong and durable, and holds nails better than pine does. But in addition to its other merits, the bark of this tree is among our most valuable tanning materials, and vast numbers of the trees have been cut down in the forests and left to decay after being deprived of their bark; treated, as one has aptly said, like the buffaloes, that are stripped of their skins and left to decay.

The spruces, black and white, deserve attention. The black spruce, especially that which grows in the Eastern States, supplies a lumber which, for many purposes, may be substituted

for the white pine. For joists and roof-beams it is preferred, as also for the lighter spars of vessels, because it is stiffer. For boards also the spruces are extensively used in place of pine. The Norway spruce is completely naturalized in our country, and deserves consideration by the tree-planter. It is one of our largest and finest trees, and second only to the hemlock in beauty and for ornamental purposes. When allowed sufficient space it spreads its branches widely and in a downward direction, so that after a few years they rest upon the ground, and the tree rises thence, as almost a solid cone, to a height of seventy feet or more, forming at all seasons of the year a delightful object. This spruce will be found among the best trees for making shelter-belts on the exposed prairies and along the sea-coasts, and wherever there is occasion to form screens to protect from troublesome winds.

In speaking of planting by the sea-coast, however, it ought to be borne in mind that many trees will not bear the exposure to winds which are not only severe in themselves but are also laden with salt-spray. It is thought that

some of the hard-wood trees bear this exposure better than the evergreens, and that the latter do better when they have a row or two of such trees as the poplar or the bass-wood planted nearest to the water to form a partial screen for them. But, wherever trees are exposed to strong winds, they bear the exposure better when planted in several rows than when they are in a single line. They seem in the former case to give each other support.

The cedars are as widely diffused in this country as any trees we have. They are found, especially the red, in almost every kind of soil and situation. There is no place where we can affirm that the latter will not grow. And it is one of our best trees. It is noted for its durability. Hence it has been in great request for fence-poles, for hop-poles, bean-poles, and the like, and for railroad-ties. It is also a fine-grained wood, and desirable for many uses in cabinet-making and house-building. Its color and peculiar fragrant odor add much to its other merits. It is the wood of which our lead-pencils are made, and is in request for the construction of chests and drawers, as its odor is

supposed to be a safeguard against insects injurious to clothing.

Our stock of native trees is so large that we hardly need to seek any from abroad. And yet some European trees of similar kinds to our own are found to be of better quality than ours. Some of the English oaks, elms, and birches are better for some purposes than ours of the same name. The European larch is better than the American, and is to be preferred for planting here.

Among evergreens the Scotch pine (*Pinus sylvestris*) has been noted for its rapid growth and its adaptation to almost every variety of soil, as well as for its valuable qualities as a timber-tree. It is a favorite tree in Europe. It has not been growing with us for a sufficient time to warrant a decisive opinion as to its merits. It has seemed to give promise of being a valuable accession to our list of trees. Latterly, however, there has come up some distrust of it. Trees which had previously grown well, and appeared vigorous, on reaching the age of twenty-five or thirty years have seemed speedily to lose their vitality, and so there has begun to be doubt

whether this will become a desirable timber-tree with us. The fact thus noticed may be the result of peculiarity of situation. It needs further time and investigation to determine. It may be the result of the use of bad seed. The true Scotch pine, a native of the cool north, does not bear seed profusely. But there is a degenerate pine of this sort, growing in France and the neighboring countries, which seeds freely. On this account, the seed of the latter is most abundant in the market, and the inferior tree has been widely disseminated as the result. To be sure of the best trees, it would be well to procure seed from a better source. Seed of the genuine sort, or trees, may be obtained without difficulty from Riga, Russia, a source from which it will be advantageous to procure many kinds of trees and seeds, especially for use upon the dry, cold prairies of the Northwest, a region quite akin to some portions of the Russian country. Genuine seed may also be procured from some of our own dealers.*

The "Iowa Forestry Annual" recommended,

* The best Scotch-pine seed is that known as *Pinus sylvestris*, variety *Rigensis*.

several years ago, a combination of the Scotch pine with other evergreens for shelter-belts, and proposed two or three rows of white pine for the center, two rows of Scotch or Austrian pine on each side, and two rows of red cedar, or arbor-vitæ, outside of these.

We have thus indicated some of the more desirable trees for the planter's use, our design having been to call attention to those which are of established character and recognized worth, and such as are likely to prove successful in the hands of the ordinary planter. We have endeavored, by limiting the number of trees treated of, to avoid confusing the mind of any reader, for persons confused by attention to too many are likely in the end either to abandon planting altogether, or to make such a choice as will leave room for subsequent regret. It is better for the inexperienced to devote their attention to a few of the various kinds of trees than to undertake at once to plant many sorts. Their work is thus simplified, and for this reason will be more wisely and thoroughly performed than where the culture of a greater variety at the same time is undertaken. When experience

has been gained in this way, and an intelligent interest in trees has been established, the planter may properly, as he will be likely to do, add to the value of his plantation, and, at the same time, to his own pleasure, by experimenting with less common trees, testing their value, and adding them to his plantation as he finds them to serve his purpose. His tree-planting, which was at first, perhaps, a stern necessity, and entered upon with much doubt and uncertainty, now becomes a source of constant enjoyment. The trees are his friends, and he delights to widen his circle of acquaintance among them continually. And he may widen it to any extent.

IV.

HOW TO PLANT.

THIS is the most practical of all questions with the tree-planter. He may feel the need of trees, he may be full of craving for their society, he may even have made his selection of trees and decided where they shall be placed; but all may come to naught, all will come to naught, if the actual planting is not done aright.

The first requisite for a successful tree-planter is that he shall recognize the fact that trees are living organisms. To plant a tree is not to fix a post, or to set a stone in place in a wall. Yet much of our tree-planting has been done with as little adaptation of means to ends as if such were supposed to be the work in hand. Very often little regard has been paid to the condition of the tree in itself, or in its relation to the soil or climate of the

region where it was to be placed. Then, in its committal to the ground, there has often been the least possible consideration of the proper requisites for a vigorous and successful growth. The work has been intrusted but too frequently to persons altogether uninterested in its success, and ignorant of the necessary conditions of growth. A hole has been hastily dug in the ground, just large enough, probably, to allow the roots of the tree to be crowded into it, the lumpy earth has been shoveled back, the stamp of a boot-heel given to it, possibly a dash of water added, and the work has been considered complete, and the tree expected to grow without further attention. If failure has resulted, as it has in so many cases, the result has been attributed to the peculiarity of the season, or to any other but the true cause, the ignorance or carelessness of the planter or both together.

Looking upon the tree, then, as a living thing, having organs of delicate sensibility and special functions, common sense would decide that attention should be given, first, to the place where it is to grow—that is, where it is to feed and have its life sustained. The character and

condition of the soil, then, are first to be taken into account. These are prerequisites to the thrifty growth of a tree, such a growth as every planter wishes to secure. A calf or a colt will live and possibly make some growth on a scanty pasturage in summer or on straw-fodder in winter. It will barely live. But no successful stock-raiser, no one worthy to be considered as a stock-raiser, feeds his animals in that way. So a human child will possibly live and maintain a feeble existence upon slop milk or when the diet is defective in quality and insufficient in quantity, though many drop off and die from such causes.

Now, the soil is the source of the tree's nourishment. The roots of the tree are its mouths —or, more properly, its mouths are in its roots. What we call the roots are, in part, only a mechanical contrivance by which the tree is held in an upright position—a brace, so to speak. But these underground arms branch off into fingers innumerable, which are covered with hairs or rootlets, somewhat as our own fingers are. In these are the mouths of the tree, so small as to be invisible. It is clearly impossible, there-

fore, that any food should enter these mouths except in a fluid state, either liquid or gaseous.

The soil ministers to the life of the tree planted in it, only as the plant-food contained in the soil is dissolved, so that it can be absorbed by the minute mouths of the roots. Hence the need of having the soil reduced to a fine condition, having it "pulverized," as we say—that is, reduced to a state of powder. In proportion as the soil is thus made fine, more particles of plant-food are exposed to the action of the water and gases, which are ready to dissolve them, and in proportion to its fineness are the dissolving particles brought into contact with the little mouths ready to take the food thus prepared for them. In other words, the tree needs to have its food prepared for it in soluble form; and to this end the soil in which it is to stand and make its growth must have among its constituents appropriate plant-food, and must be put into such a mechanical condition as will enable the tree to appropriate the food that is offered it.

The farmer or gardener does not expect to have a crop of corn or wheat unless he prop-

erly prepares the ground beforehand, or chooses a soil already stored with the elements of plant-food, and then, by means of plows and harrows, brings it into the best mechanical condition to supply the roots of the corn or wheat with their food. Why should he be any less careful in regard to the growth of his trees, those nobler plants? The principles in which success is involved are the same in both cases. There is no difference; only, as the life and growth of the corn or wheat are limited to a single year, or a few months of the year, whereas the tree is to reach its maturity only after the process of growth has been carried on for scores, perhaps for centuries of years, the preliminary preparation for its work ought to be undertaken with the greater care.

It is because it is not so undertaken, but oftentimes less care is given to the planting of an oak than to a few grains of corn, that half the failures in tree-planting occur. Instead of wondering that so many trees after being planted never put out a green leaf, or that, after showing some feeble signs of life, they die utterly in a year or two, the wonder should be

rather that so many live at all. The trees treat us better than we treat them. They more than repay us for our care. They triumph over difficulties and discouragements astonishingly oftentimes. Life is a mighty power and works miracles almost. But we can not expect the trees to work miracles to make up for our negligence.

Let it be understood, then, by every planter, whether he be the owner of a little village plot and wishes to plant but a single tree or a clump of trees in his door-yard to beautify it, or is possessed of a stretch of treeless prairie beyond the Mississippi, which he wishes to clothe in part with trees and so bring it into a pleasant and comfortable condition for human occupancy, that the first thing to be done is to see that his ground has a proper supply of plant-food—though in most cases Nature will have provided that—and that the soil is so triturated and mellowed that his trees can easily take their food into their mouths. This is the most essential thing.

Neglect at this point is at the expense of further growth and ultimate success and satis-

faction. Neglect here in order to secure a speedy planting will furnish another illustration of the truth of the proverb, "Haste makes waste." The planter on the prairie which has never been broken may, perhaps, venture to plant his corn or sow his wheat upon the freshly-turned sod without further care, and those plants of a season will give him a sufficient return for his labor, for there will be enough pulverized soil to meet the demands of their short life. But if he is about to grow a crop of trees, how inadequate does such treatment appear to any intelligent mind! It is only a waste of time and ground. Let him rather hasten slowly. Let him plant no more trees in any given year than he can plant properly and well. A hundred trees so planted will be worth more to him than a thousand thrust into ground not suitably prepared.

Let him break up his ground in the spring or early summer—that is, at the customary time—and in the autumn cross-plow it or turn it again, sinking his plow as deep as he can. The next spring let him plow again, and go over the ground with the harrow, lightening the labor

with the thought that he is doing a work not only for the present year, but for ten, twenty, it may be fifty years to come. To secure a more complete preparation of the ground for his tree-crop, let him for a year plant it with potatoes or some seed which will call for the use of the hoe or cultivator, and thus kill off the weeds which otherwise might kill his trees by taking their food from them. Now he may plant his trees, though there will be no loss if he waits still another year and works the ground yet more thoroughly with another temporary crop. At the end of ten years he will probably see in the stalwart growth of his trees that his seeming delay was really the best hastening.

Meanwhile, with his first breaking of the ground, if he expects to grow his trees from the seed, he should have procured the seeds and planted them in a nicely pulverized seed-bed, where the young trees can be watched and kept free from weeds in their tender infancy. If he transplants them from one seed-bed to another at the end of their first year's growth, and plants them where they are to stand finally

only after they have grown another year in the seed-bed, it will be all the better. They will have multiplied their roots so as to be able to take hold of the soil of their permanent home with the greater vigor and assimilating power, and will make a more rapid and sturdy growth.

By planting seeds in the seed-bed or nursery at the same time that the field is taken in hand to be made ready for the ultimate planting, the trees will be getting ready to be planted while the ground is being prepared by thorough cultivation to receive them and give them a good send-off, so that no time will have been lost.

But the question comes in here, whether it is better for one to plant the seeds of trees, or to procure trees for planting from those who make it their business to raise them for sale.

Of course, if one is about to plant only a few trees, he will hardly hesitate about purchasing them, rather than be at the trouble of raising them from the seed. But the question respects chiefly those who may be proposing to plant on the large scale, as, for instance.

shelter-belts about their farms, or to comply with the terms of the Government timber-act. For such even, unless they have had considerable experience in raising trees from seeds, it will be policy to procure trees rather than to sow seeds. The practiced planter, if he has the time and facilities for doing it, and if he also enjoys this part of the work, may begin his plantation at the seed-bed, or by gathering his seeds where Nature has produced them, or from the dealer who offers them for sale. But one who has had little or no experience will ordinarily do best by purchasing trees rather than by planting seeds.

Time and trouble are involved in gathering seeds; and, if they are purchased, there is the risk that they may not be in proper condition to germinate, or may not prove true to name. And then there is a great deal of care demanded in the seed-bed. There are weeding and shading and protection. The young pine, though it may be a giant by-and-by and bid defiance to sun and storm, is at first a very tender and delicate plant. There is hardly one in the lady's flower-garden more so. It needs to be

shaded from the sun, and to be supplied with moisture in proper measure. So of other trees. They require much fostering care to bring them forward from the seed to a condition for successful growth in the field or forest. The professional tree-grower or nursery-man can give this care, for that is his business, and there is nothing to interfere with it. Prosecuting the business also on a large scale, he can not only grow trees more successfully but more cheaply than others. On all accounts, therefore, it will usually be best for the one about to plant a grove or a forest to purchase trees rather than to plant seeds.

But, if one is resolved to raise his trees from the seed, there are some considerations to be offered which may be of service to him. If he does not go to the dealer and purchase his seed, when shall he gather and when shall he plant it?

Nature, here as elsewhere, is our great teacher. She never makes a mistake. She plants her seeds when they are ripe. When they have arrived at maturity, when they are so perfected that they are in a condition to repro-

duce their kind, thus fulfilling the law of creation, under which the herb and the tree were ordained to yield seed each "after its kind," they are dropped upon the ground by the parent tree, and there find the conditions of shelter and moisture which enable them to germinate. Our lesson, then, is before us. We should gather the tree-seeds when they are ripe.

This, also, is the appropriate time for planting them. It may not be convenient for us, however, to plant them at once. When, for any reason, the seeds can not be planted at the time of ripening, common sense would indicate that they should be kept, if possible, in such a condition that their power of germination will not be impaired. This is sometimes a difficult matter, owing to the different characters of seeds. The late Dr. John A. Warder, of Ohio, to whom the country is as much indebted as to any one for the interest which has been aroused in recent years in favor of forest tree-planting, has treated the subject of gathering, preserving, and planting seeds so well, in a paper prepared by him for the Minnesota State

Forestry Association, that we feel that we can not do better than to draw very liberally from it for the benefit of our readers.

For convenience of treatment, Dr. Warder divides seeds into five classes: 1. Soft seeds. 2. Berries and pulpy seeds. 3. Nuts and acorns. 4. Hard seeds. 5. Coniferous seeds. "All seeds," he says, "are best gathered as soon as they are ripe, or even a little before their perfect maturity."

Class I.—Soft Seeds.

"When any of these kinds stand over a pavement or smooth and clean piece of ground, they may be allowed to perfect their ripening upon the trees, as the fallen seeds can be swept up and gathered—for it will not pay to pick them up singly.

"The white maple, in its favorite habitat near water, may be allowed to shed its seeds, which float in the stream and are collected in the eddies, and may be drawn out with a rake, to be dried and planted immediately. These maple seeds are ready for germination as soon

as they ripen, and indeed they are already young plants, as may be seen by breaking them open; hence the difficulty of preserving and transporting them. Once thoroughly dry them, and their vitality is lost.

"The elms, with a single exception, are also early summer fruits, ripening in some cases before the expansion of the leaves. This, however, is an advantage to the seed-gatherers, who can strip them from the limbs just as the winged seeds begin to turn brown and are ready to fall. The seeds of the elms are less impatient than the maples, and retain their vitality sufficiently to admit of transportation to a distance, but it is better to commit them to the soil as soon as possible.

"Poplars and willows also blossom in the early spring, and ripen their seeds before the summer heats. Their seeds are produced in elongated catkins. They must be harvested from the trees. This is done just as the catkin begins to burst open in ripening. The minute seeds should be sown at once on a finely-prepared seed-bed and very lightly covered by sifting fine soil over them, and then firming the

surface with a board or the back of the spade, or with a light roller.

"Birches and alders have small and winged seeds that are also produced in catkins. They blossom very early and ripen their fruit usually in the autumn, when they should be collected and laid away to ripen and shed out. These may be sowed in beds at once, or they may be kept over winter in a suitable seed-room, where, after sufficient drying, they should be kept covered from the air.

"Mulching will be found serviceable with all these small seeds that are sowed in summer. Freshly-mown grass, short broken straw, or autumn leaves, will do if spread so lightly as to let the sunshine through the material.

"Some other seeds are endowed with greater vitality, and may be kept for a longer time out of the ground. The different species of the ash have seeds that belong to this class, and some of them, if kept dry during the winter, will not vegetate until the second year. It is better to sow these in drills in the autumn, or to winter the seeds out-of-doors by throwing them upon a hard surface, such as a gar-

den-walk, and covering them with some loose boards or an inverted box, or they may be mixed with an equal bulk of damp sand and kept in a cool room under shelter; but do not allow them to become too dry."

Class II.—Pulpy-fruited Seeds.

"The seeds of berry and pulpy-fruited plants need especial treatment. Thus, mulberries, elders, currants, and other fruits with small seeds imbedded in pulpy matter, need to be macerated in water and washed, then dried, when they may be preserved.

"Peaches, plums, and cherries should have the pulp separated from the stones, and these, when dried, may be stored or transported at any time, but their germination is much aided by exposure to the frosts of winter. The larger may be thrown upon the ground and lightly covered with earth. The smaller seeds may be mixed with sand and exposed to frost and moisture in the vessels containing them, and should be planted early in the spring."

Class III.—Nuts and Acorns.

"These should be gathered as soon as they fall, separated from their hulls or cups, and partially dried, if to be stored.

"Most of the oaks, and notably the chestnuts, need to be gathered as soon as they fall, and then partially dried, as they are prone to germinate immediately on the damp earth, and their tender radicles are easily broken off in handling. It is best, therefore, to mix these seeds with moderately damp sand so soon as gathered, and keep them in the coolest temperature and under cover. Better still, however, where practicable, to plant them in the drills as soon as convenient after they are procured.

"Walnuts and hickories are easily managed, and may be preserved in good condition if kept dry and cool; but, if too warm, these oily seeds are liable to become rancid, when their vitality will be destroyed."

Class IV.—Hard Seeds and Refractory.

"Some seeds are so indurated, or so closely and carefully incased, that their vitality is pre-

served from injury for years, even under exposure to the elements. Of these the common black or yellow locust gives an example. The seeds of this tree may be gathered at any time during the first half of winter, and can be kept almost indefinitely, but they require preparation before planting. This is usually done by scalding and soaking. The swollen beans are to be separated with a sieve and at once committed to the soil. The scalding process may need to be repeated several times before all the seeds become swollen."

Class V.—Conifers.

"Pines, spruces, firs, and such trees, ripen their fruits successively, and each must be gathered in its season, from the trees. This must be done before the scales of the cones begin to gape and shed the naked or winged seeds. Many of these species require a considerable time to mature, and some need the aid of artificial heat to make them gape and shed their seeds. When separated from their cones, many of these seeds can be safely kept by preserving a regular and moderate tem-

perature in the seed-room. The bags, boxes, or drawers should be closed, so as to avoid too free an exposure to the atmosphere and humidity."

Cuttings.

There is one method of propagating trees of which we have as yet said nothing, that is by cuttings. Many trees are so easily propagated in this way, that it has been adopted quite extensively. It consists, as most know, in inserting in the ground pieces of well-grown wood nearly to the extent of their whole length, leaving only one or two joints or buds above-ground. Most persons are aware that the willows, treated in this way, readily push out roots and grow. But so will the cottonwoods, the box-elder, the maples, the sycamore, and many others. Prof. Budd, of Iowa, one of our best authorities upon trees and tree-culture, speaks thus in regard to the treatment of cuttings: "They should be cut early in winter, before severe freezing, in lengths of about one foot. They should be chosen from three fourths of an inch to an inch and a half

in diameter, and the lower end with a clean cut, without bruising or mashing. Of maples, the two-year-old wood is best; of the other kinds it makes but little difference, if the growth is free and healthy. Tie in bundles with willows, the lower end nicely evened, so that when placed on the ground in spring every piece will touch the moist earth. Pack the bundles in a dry-goods box with moist prairie soil, putting the box where it will not get too dry or wet, and will not freeze. With the first warm weather of spring, clean off a spot under an old hay-stack, level the surface carefully, and set the bundles, butt-end down, closely together, upon the fresh, moist earth, then cover them with straw so as to keep them from the air. By the time the ground gets warm enough to plant, the base of the cuttings will be softened, and most of them will have small roots."

Process of Planting.

We have already said enough, perhaps, concerning the roots of trees and their functions

to make any further remarks about the process of planting unnecessary. And yet mistakes are so often made in regard to this matter, and failure and disappointment are so often entailed as the consequence, that a few words still may not be superfluous.

If, as we have said, the roots contain the mouths of the trees, the organs by which they take in their nourishment and secure their growth, then the more widely these mouths are diffused through the ground, and the more intimately they are brought into contact with the soil and the plant-food which it contains, the more certain and vigorous will be their growth. Hence the need, already intimated, that the ground should be mellow and minutely subdivided, so that the trees may easily push out their rootlets to the utmost extent, and that the soil may be brought into closest contact with them.

This indicates the course to be pursued at the time of planting. It is not enough that a hole be made of barely sufficient size to admit the roots of the tree as they then are, very likely diminished from their natural amount

because a portion of them—and that the most important portion—has been cut off by the spade in the act of taking the tree from its former place of growth. The excavation should be ample, and the ground around so soft and permeable that as new roots are made they may be able to push out in every direction. The roots, as they are at the time of planting, should not be thrust in at hap-hazard, but should be spread well asunder, and the earth should be carefully pressed into the interstices and firmed around the small fibers, remembering that the feeding mouths of the tree are upon them rather than upon the bulky roots, which are more buttresses for keeping the tree in place than feeding organs.

To secure this proper planting, the planter should select a time for his work when the ground is neither too dry and hard, nor too wet and pasty—the one state being about as bad as the other—but a time when the earth will work readily under the spade and the hand. After covering the roots properly, as we have described, he should fill the space left above them, an inch or two in depth, with

fine but loose earth, in order that the air and moisture may have ready access to the roots; then, finally, cover the surface with a mulch of some sort—leaves, straw, tan-bark, chip-dirt, or the like—for the purpose of screening it from the sun and wind, which would rob the roots of their appropriate moisture by the rapid evaporation which the former would occasion.

If the ground is in proper condition, it will seldom be necessary to apply water to the trees when planting them. The nurserymen make little use of water at such time. To have the earth fine and simply moist, and to have it brought into close contact with the fibrous roots, is the important matter. A dash of water, as the earth is being packed around the roots, may assist, but unless care is used the water may do more harm than good.

Some may say this is an ideal method of tree-planting, one that can not be carried out in practice, or only in special cases and where but a few trees are to be planted. It may be that the forest-planter can not take all the pains with his work that we have indicated as desirable. But let him hold this ideal plant-

ing in mind, and come as near realizing it as he can. On the lawn, in the door-yard, in the garden or orchard, by the road-side, this ideal should always be reached. On the prairie, or where one is planting a forest of acres in extent, let him do the best possible. He can at least have his ground in good condition. He has no excuse if he does not. And though he may feel that the work of planting, when done on the large scale, must be done rapidly, it need not be done carelessly. With the aid of children's fingers, the trees being small, as in forest-planting they usually will be, he can come reasonably near to the proper standard of tree-planting.

After-Care.

But, having planted ever so carefully and well, the growth of the trees is not yet secured. They need to be watched afterward and guarded from injury. The one who plants a single tree or a few trees near his dwelling, to beautify his home and make it more pleasant, more home-like, will hardly fail to watch them and see that nothing interferes with their welfare.

He will guard and protect them in every needful way. But the one who plants on the larger scale, the one who is planting a grove or a wind-break covering acres in extent, the one who is undertaking to secure his timber-claim on the prairie, is in danger of neglecting his trees after having planted them, and of suffering loss in consequence, perhaps of finding his tree-planting almost, if not quite, a failure. He is likely to be a farmer, occupied with other crops as well as with his trees. He may not be, probably is not, a capitalist, with the means of employing all the help he needs. He is struggling, it may be, with the hardships incident to a new settlement, and is carving out his future with his own hands. Pressed with the other and ordinary cares of his farm, and knowing that the trees are not to make immediate returns of value, like the corn, he will be very likely to leave them to themselves, and to think that, as they have been planted, they will of course grow. The consequence is, that weeds spring up among them and rob them of their needed nourishment, or they wither for lack of protection from the sun and wind.

In multitudes of instances the want of proper care after planting has blasted the planter's hopes. Sometimes this neglect is the result of simple ignorance. The planter knows little about trees. So far as he has seen them, in forests or in orchards, he has seen them left to themselves, growing without having any care or culture bestowed upon them, and he thinks he may treat his trees in the same way. But after-care is as important as proper planting, especially in the case of young and tender trees, such as are commonly used in extensive planting. The tree-planter should consider it as important to go between the rows of trees, from time to time, with the hoe or the cultivator, as to go between the rows of corn. It is important, for precisely the same reason, to keep down the weeds and grass and to stir and open the soil so that the air, the rain, and dew may readily penetrate it. After giving the trees such care for two or three years, they will have thrown out branches to such an extent as to shade the ground sufficiently to suppress the growth of weeds, and thenceforth they will take care of themselves, except that

they must be protected from the incursion among them of cattle and other animals which might trample them down or feed upon them.

How far apart to be planted.

It is a question of much importance at what distance apart from each other trees should be planted. While within the seed-bed, they may be planted within a few inches of each other and in rows just sufficiently far apart to allow the ground to be worked so as to keep down weeds. When they have attained a height of from twelve to eighteen inches, they will need to be transplanted and to have more room. When transferred to the nursery, they should not be placed nearer to each other than six inches for those kinds of trees that have a slender form. Those of a more spreading habit may be set at the distance of a foot; and the evergreens, which throw out branches near the ground, may be placed eighteen or twenty inches from each other.

There is some difference of opinion as to the distance from each other at which trees

should be set in the final planting in the field. The timber-culture act of Congress was found, in practice, to be defective, because it allowed trees to be planted at a distance of twelve feet from each other. Practical experience teaches that they should be planted much closer than this, and there is now a very general concurrence of opinion that the best results are obtained when trees, for forest purposes, are planted not more than four feet from each other, and in rows four feet apart. Some would plant even closer than this. If planted at a greater distance, the trees, when young and tender, are very likely to be injured by sweeping winds, especially in the prairie regions. They are also more exposed to the withering effect of the hot sun, and are liable to have the soil parched and deprived of its moisture by excessive evaporation, whereas, if planted closely, they afford mutual support, shading the ground so that its moisture is retained, while at the same time weeds are prevented from growing.

Moreover, this is Nature's mode of planting. When cattle and other injurious animals are

excluded from our native forests, we see the young trees spring up thickly and grow in close order, and, instead of spreading out their limbs to a great extent near the ground, the tendency is to shoot upward, making tall trunks, the lower branches gradually withering and dropping off. So we are told that in the forests of Oregon and Washington Territory the great trees often stand so close together that a principal difficulty in converting them into lumber is to find vacant space enough to allow their fall to the ground when cut. Of course, these giants of the wood, which have been growing during one or even two hundred years, do not stand within four or, perhaps, twenty feet of each other. Nor is it meant, when we speak of planting trees so close together, that they are to preserve that closeness for a great length of time. After a few years they will begin to crowd each other and interfere with one another. Then a thinning process must be commenced. At first one fourth may be removed; after a few years more, another fourth. The general statement may be made that one half of the trees should be removed before they

have attained a height of twenty feet. The trees thus removed from time to time will be valuable for hoop-poles, vine-stakes, fence-poles, and for many other uses. The remaining trees will now have room enough in which to grow for another term of years, when a further thinning should take place. When the trees have reached an average height of thirty feet, not more than eight hundred should be left on an acre; and, when forty feet, not more than three hundred or three hundred and fifty under the most favorable conditions of soil and exposure. Then the trees may be left to themselves, only removing from time to time the dead or decaying ones. As the successive thinnings take place, the trees which are removed will be more and more valuable for lumber on account of their constantly increasing size.

It is usual also with the most experienced tree-culturists, in view of the anticipated thinnings, to plant various kinds of trees together —planting, for example, oaks, if the design is to have the final forest mainly of this tree, sixteen or twenty feet apart, and filling in the intermediate spaces with other trees, such as the

ash, the larch, the pines, or other trees which grow to maturity or to a valuable size sooner than the oak, and may be economically used at an earlier period.

It is found also that a better forest-growth can be obtained when different kinds of trees are planted together than when a plantation is made of one kind exclusively. This may be because the different kinds of trees appropriate for their nutriment different elements of the soil, or because some have their roots near the surface, as the beech and the hemlock, while others, like the oak, send theirs downward, and so they feed at different depths, and do not interfere with or limit each other's pasture.

The appearance of a grove or forest is certainly more pleasing when several kinds of trees are planted together. However satisfactory in look a single tree may be, or a few of the same kind, when we meet it in masses to the exclusion of others it becomes less pleasing and may even become unwelcome. The mind craves variety. So we never tire of our native forests, because they are usually made up of many kinds of trees. We do not plant a sin-

gle kind of tree, to the exclusion of others, around our dwellings. We do not on the lawn; why should we, when planting on the larger scale? Although our chief aim may be to secure trees for practical use, for shelter-belts or for timber or fuel, there is no reason why we should not combine beauty with utility. We may make a belt of trees or a forest beautiful, and more beautiful than it would be otherwise, not only by our choice of trees, but by our method of disposing of them in planting.

Avoid Checker-Board Style.

And we are inclined to emphasize this suggestion, in reference to the West, and especially to the prairie region, where there is so much planting to be done. There nearly all the roads and farm boundaries run in straight lines, according to the Government surveys, and as the result of those surveys. This is very convenient for some purposes, but it is anything but favorable to æsthetic or landscape effect. It makes a great checker-board of the western portion of our country. It gives it a

stiff and far less pleasing appearance than the older portions, with their winding roads and fields of varying and irregular forms. When you have seen the shape of one farm you have seen the shape of all. And there is danger that, as the tree-planter undertakes his work, especially in those parts of the country most destitute of trees, he will increase this checker-board, this artificial appearance, by planting his trees in straight lines along the boundary of his farm on one or more sides. This he will be apt to do for the purpose of getting a shelter-belt, as it is called, to screen himself, his crops, and his stock from hurtful winds, while he hopes also to derive from it in due time a sufficiency of lumber and fuel. It is also the easiest, because the simplest way of planting. His lines are all set for him. But if he follows this course he will find, when his belt of trees have grown, that he has shut himself in, imprisoned himself, so to speak, within a stiff, square wall fifty feet or more in height.

Let him avoid this, which will be a lasting source of regret when the trees have become established. And he may avoid it by a little

consideration beforehand. Instead of planting in parallel rows along the border of his farm, it will be better to plant shelter-belts only where they are plainly needed, and then to plant them more or less in curved lines conformed somewhat to the natural curves, the elevations and depressions of the fields themselves. Instead of a continuous belt of trees along the farm-border, whether upon one side or more, it will be much better to leave openings here and there, through which to look out upon the pleasant stretches of country around.

By a little forethought in this respect, selecting and combining various kinds of trees, planting some upon the most elevated portions of his wide-spread farm, and drawing about his dwelling the bright birches and the cheerful evergreens for shelter and companionship in the long winter, he may make his prairie homestead most beautiful while doing what will make it also most productive.

People of the prairie region are quite awake to the desirableness and even necessity of extensive tree-planting, and in numerous publications plans have been suggested for

the best disposal of the trees. But, so far as we have seen, they all have the fault of arranging them in stiff, straight belts, or in square blocks equally stiff. Now, Nature does not give us straight lines, except in rare instances. Only Art does this. Nature moves and builds in curves. Clouds, streams, mountains, fields, snow-drifts, all have curved and graceful outlines. The flattest prairie ever seen has at least its occasional gentle swells, as though struggling against the irksome monotony of a dead level. And the tree-planter may well take a lesson in this respect from Chicago and what has been done there in her now beautiful parks, which have so changed the aspect of the place. That city is now an object-lesson for all the region around, not only of business energy and success, but of taste and refinement. So effective are simple means when rightly used. In like manner may any dweller on the prairies, by taking advantage of the contours of his fields and massing his trees in graceful forms, make his tree-planting a source of constant beauty as well as substantial benefit.

And what we have said in regard to planting on the prairie applies more or less to planting everywhere. In the door-yard and on the lawn care should be taken to avoid the stiffness and mechanical look which will be the result of planting in straight lines. City lots and streets are, almost necessarily, bounded by such lines. But even a city lot can be changed from a square inclosure or pen into a lovely pleasure-ground, by a little care in selecting trees and shrubs of various character and throwing them into graceful curves, instead of ranging them in lines parallel with the boundary fences.

Planting Evergreens.

We should leave the last of our questions answered incompletely if we were not to add a few words in regard to the planting of evergreens, or the conifers, including the larches and some others which are not strictly evergreens. These trees are in themselves so beautiful, and add so much to the general effect of planting, by the pleasing variety

which they give when mingled with other trees, while also so valuable for constructive purposes, that their cultivation is very desirable. They are, in a special sense also, the home trees, or trees to be planted near or within sight of our dwellings, particularly in the northern portions of the country, where winter reigns throughout so large a part of the year and the snow lies like a winding-sheet upon the face of the earth. In such places how cheerful, how like the presence of friends, is that of these trees in their livery of perpetual green, mocking at the death-like torpidity around, making the very snows themselves to take on the aspect of life and beauty, as they catch them in their extended fingers and wreath them in graceful folds, or wrap themselves in them as in a mantle of ermine! How grateful the presence of these trees also when a belt of them is interposed between one's dwelling and the cutting blasts which pour down from the north! What a perfect screen also they furnish with which to shut off any disagreeable or unsightly object near the dwelling or within the range of vision!

But we have not had the benefit of this class of trees as much as we might have done, because they have been regarded as so difficult of cultivation that many have not even attempted it. The frequent failures of those who have attempted it have given, it must be confessed, much reason for discouragement. Who has not seen these trees, looking bright and fresh at the time of planting in the door-yard or on the lawn, very soon beginning to take on that reddened hue which is the sure sign of departed vitality?

The most frequent cause of failure has been ignorance on the part of the planter, and often also on the part of those of whom he has procured the trees, in regard to the peculiar character of this class of trees, and the peculiar treatment therefore demanded. The evergreen or coniferous trees have a resinous sap, to say nothing of any other and minor peculiarities in which they differ from the broad-leaved or deciduous trees. If this resinous sap is once allowed to be checked in its flow or hardened by the exposure of the tree-roots to the drying influence of the sun or wind,

the circulation of the vital fluid is stopped forever. No application of water, though in floods, will start the flow again. It is not so, as we know, with other trees.

An Imperative Rule.

Hence the imperative rule for all successful planting of evergreens—*keep their roots moist from the time that they are taken from the earth until they are planted.* We mean this to the letter; for we have seen trees brought to be planted, and by those who knew something about trees, brought apparently in good condition, and then laid upon the ground to be exposed to the sun or wind while the holes were being dug for their reception; and this exposure was just long enough for them to be death-struck and the holes to be their graves. It requires but a little time for the fibrous roots to become dry, whether from sun or wind, and it is on these hair-like roots that life depends. When, therefore, one is about to plant evergreens, he can not be too careful on this point. If he purchases the trees, let him

purchase only of such dealers as know the peculiar nature of this class of trees, and who have honor enough to pack them properly for transportation. Then, when received, let the planter be sure that they are not exposed to sun or wind, but that their roots remain covered and moist until the appropriate places are made for them, and the trees are then planted. If he is about to plant from his own nursery-beds or to procure trees from the native forest, let him choose a still and cloudy or even misty day for the purpose. Let him throw a mat or blanket over the roots of the trees, as he takes them from the ground, and keep them covered until he reaches the spot where he intends to plant them. Having now the ground properly prepared beforehand, suitable holes already dug, the earth made fine, as it should be, so that it can be brought into close and firm contact with the delicate, fibrous roots with their waiting mouths, let him commit his trees to the ground again, with the care and attention which delicate, living things may rightfully claim, and he may retire from the field with a confident assurance that his labor

has not been in vain, but that his trees will reward him amply for his pains, and hold out their leafy hands to thank him in years to come.

USEFUL TABLES.

NUMBER OF TREES ON AN ACRE.

THE number of trees needed to plant an acre of ground, at various distances apart, is as follows:

2	feet apart each way	.....	10,890
3	feet by 2 feet	.....	7,260
3	feet apart each way	.....	4,840
4	" "	.....	2,722
5	" "	.....	1,742
6	" "	.....	1,210
8	" "	.....	680
10	" "	.....	435
12	" "	.....	302
15	" "	.....	200
18	" "	.....	135
20	" "	.....	110
22	" "	.....	90
25	" "	.....	70
30	" "	.....	50

Rows six feet apart, and trees one foot apart in the row, 7,260 trees per acre.

Rows eight feet apart, and one foot apart in the row, 5,445 trees per acre.

Rows ten feet apart, and one foot apart in the row, 4,356 trees per acre.

One mile of wind-breaks or shelter-belt requires 5,280 trees or cuttings for a single row, one foot apart in the row.

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